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MONOGENEA OF AUSTRALIAN MARINE FISHES. THE GENERA *DIONCHUS*, *SIBITREMA* AND *HEXOSTOMA*

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With Text-figures 1-7 and Tables 1-5

Abstract. The following Monogenea collected at Heron and Lizard Islands, Great Barrier Reef, are described and figured: *Dionchus remorae* (MacCallum, 1916) from *Echeneis naucrates*; *Dionchus agassizi* Goto, 1899 from *Echeneis naucrates*; *Dionchus* sp. from *Rachycentron canadus* (L); *Sibitrema poonui* Yamaguti, 1966 from *Cybiosarda elegans* Whitley and *Euthynnus alleteratus affinis* (Cantor); *Hexostoma euthynni* Meserve, 1938 from *Euthynnus alleteratus affinis* (Cantor). The genus *Neohexostoma* Price, 1961 is considered to be a synonym of *Hexostoma* Rafinesque, 1815.

Introduction

This paper is one of a series on Monogenea of marine fish on the Australian east coast (Rohde, 1976a, b, 1977).

Material and Methods

Fish were caught with a hand-line at Lizard Island and near Heron Island (Heron and Wistari Reefs), Great Barrier Reef. They were brought back to the laboratory not more than a few hours after catching, and their gills were fixed by pouring hot 10 % formalin over them. The parasites were collected, stained with Grenacher's carmine alum, mounted and drawn with the aid of a camera lucida.

Genus *Dionchus* Goto

Dionchus Goto, 1899, 291. Diagnosis Yamaguti, 1963, 139.

Dionchus remorae (MacCallum)

Acanthodiscus remorae MacCallum, 1916, 21-22, figs. 8, 8A.

Dionchotrema remorae (MacCallum, 1916) Johnston and Tiegs, 1922, 123.

Dionchus remorae (MacCallum, 1916) Price, 1938, 124-126, figs. 29-30.

Dionchus remorae (MacCallum, 1916) Yamaguti, 1963, 139.

Frequency and intensity of infection, localities

1 specimen on each of 2 *Echeneis naucrates* L. (Echeneidae) at Lizard Island (VIII).

74), 21 specimens on 4 of 4 *E. naucrates* at Heron Island (VI.-X. 74).

Specimens deposited in Australian Museum, Sydney No. W. 9208, 09, and USNM. Helm. Coll., Beltsville, Md., No. 74154.

Description (Figs. 1 and 2)

Body smooth or partly scalloped, flat, elongate, more or less rounded anteriorly; slight constriction at level of pharynx, most of body proper parallel-sided; prohaptor in form of a marginal glandular area; pharynx without constriction, two pairs of eyes at its anterior margin and in front of it; oesophagus short, caeca without diver-

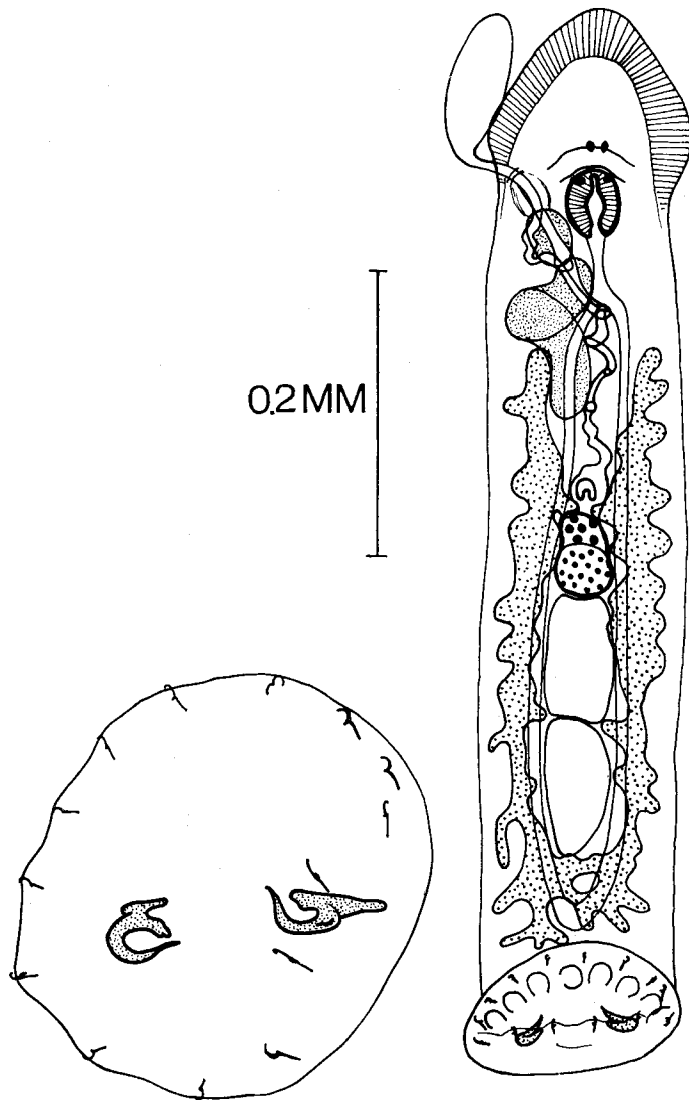


Fig. 1. *Dionchus remorae* from *Echeneis naucrates*, Lizard Island. Egg projecting out of gonopore.

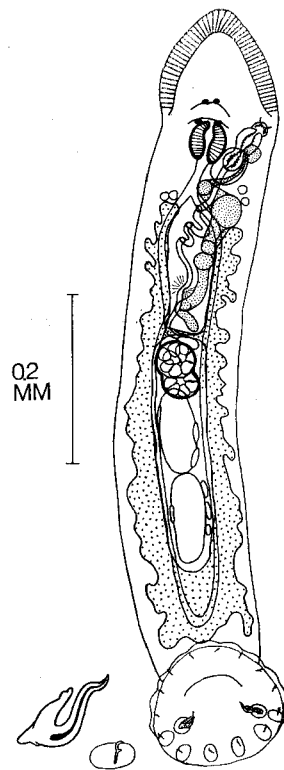


Fig. 2. *Dionchus remorae* from *Echeneis naucrates*, Heron Island.

Table 1. *Dionchus remorae*. Measurements in mm

Total length	1.1	0.9	1.3	1.5	1.02
Maximum width	0.18	0.13	0.20	0.29	0.24
Opisthaptor length	0.14	0.14	0.16	} 0.22 diameter	0.13
Opisthaptor width	0.21	0.17	0.19		0.27
Pharynx	0.06 × 0.06	0.05 × 0.04	0.05 × 0.05	0.057 diameter	—
Length of prohaptor	0.14	0.14	0.14	—	0.10
Max. width of prohaptor	0.20	0.14	0.20	—	0.13
Ovary	0.07 × 0.06	0.06 × 0.04	0.07 × 0.06	—	0.07 × 0.06
Anterior testis	0.14 × 0.10	0.09 × 0.05	0.16 × 0.10	0.20 × 0.14	0.13 × 0.16
Posterior testis	0.14 × 0.09	0.11 × 0.05	0.16 × 0.08	0.19 × 0.14	0.14 × 0.16
Hamuli	approx. 0.046	—	0.043 0.047	0.035–0.050 —	0.036 0.041
Marginal hooks	0.014 0.015	0.011 0.013	0.014 0.015	0.018	0.014 0.013 0.014
				<i>D. remorae</i> acc. to Price, 1938.	<i>D. remorae</i> USNM. 35681 Florida, <i>Caranx hippos</i>

ticula, joined anterior to opisthaptor. Two oval testes behind each other approximately in 3rd fourth of body proper, several glands of Goto (?) in their periphery; vas deferens widens to very long seminal vesicle; gonopore submarginal at level of anterior margin of pharynx. Ovary in front of anterior testis, vitellaria in lateral fields from level of short distance behind caecal bifurcation to end of caeca, joined behind posterior testis, sometimes narrow bands of vitelline follicles between ovary and anterior testis and between the two testes. Transverse yolk duct in front of ovary, ootype some distance anterior to transverse yolk duct, uterus winding, with strongly muscular metraterm which opens through common gonopore. Opisthaptor clearly separated from body proper, with two hamuli and 14 marginal hooklets. Hamuli with curved pointed blade as long or longer than base.

Egg oval, with a thick long filum at one pole.

Habitat: gills.

Differential diagnosis. Differs from all other species of *Dionchus* in its hamuli, which are smaller (0.035–0.050 mm long) and have a blade as long as or longer than the base.

Discussion

MacCallum (1916) described the species as *Acanthodiscus remorae*. Johnston and Tiegs (1922) established the new genus *Dionchotrema* for it, because *Acanthodiscus* was preoccupied. They did not include it in *Dionchus*, from which it was thought to differ in the presence of a vagina. Price (1938) established that a vagina is absent and transferred the species to *Dionchus*. He described *D. remorae* on the basis of material from *Echeneis naucrates* at the New York Aquarium and in the West Indies, and of a single specimen from *Caranx hippos* (L.). The dimensions of the body and various organs, and particularly the structure of the opisthaptor and the hamuli is approximately the same in Price's material and mine. Price, however, does not mention a muscular metraterm; he refers to a cirrus instead (see discussion for *D. agassizi*).

Hargis (1955) recorded *Dionchus remorae* from the gills of *Echeneis naucrates* L. in the Gulf of Mexico, Florida. *D. remorae* was also reported from the eastern Mediterranean (Ilan and Kohn, 1964, cit. Rao and Madhavi, 1967), and from the gills of *Echeneis naucrates* on the Tunisian coast (Ktari, 1975). Young (1970) found it on the same host at Heron Island, Great Barrier Reef, and Radha (1975) on *Chorinemus lysan* (Carangidae) on the Madras coast.

Dionchus agassizi Goto

Dionchus agassizi Goto, 1899, 286–291, figs. 19–24.

Dionchus agassizi Goto, 1899, Yamaguti, 1963, 139, fig. 502.

Frequency and intensity of infection, locality

4 specimens on 2 of 4 *Echeneis naucrates* L. (Echeneidae) at Heron Island (VI. and X. 74).

Specimens deposited in Australian Museum, Sydney, No. W. 9207.

Description (Fig. 3)

Body smooth, flat, elongate, triangular prohaptor in form of a marginal glandular area tapering towards anterior end; most of body proper parallel-sided. Pharynx without deep constriction, two pairs of eyes at its anterior margin; oesophagus very

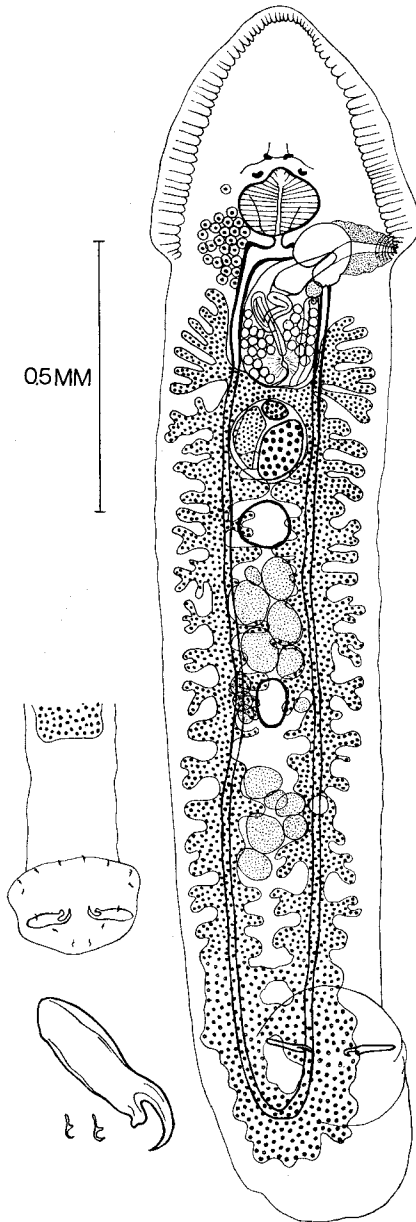


Fig. 3. *Dionchus agassizi* from *Echeneis naucrates*, Heron Island.

short, caeca thickwalled without diverticula, extending to end of body proper, joined posteriorly; two irregularly round testes in median field; several large glands of Goto (?) behind posterior and between anterior and posterior testes, vas deferens widens to seminal vesicle, gonopore marginal at level of posterior margin of pharynx. Ovary coiled-tubular in front of anterior testis; branched vitellaria in lateral fields of body proper from level of short distance behind gonopore to in front of opisthaptor, joined in front of ovary, behind 2nd testis and in posterior part of body proper. Ootype anterior to ovary, coiled uterus may contain one egg and opens with male gonoduct through common gonopore. Opisthaptor clearly separated from body proper, with two large hamuli and 14 marginal hooklets. Hamuli with curved pointed blade much shorter than base.

Habitat: gills.

Differential diagnosis. Differs from *D. remorae* and *D. sp.* in the shape of its hamuli, which have a much larger base than blade, and from *D. rachycentris* in the smaller size of the hamuli (0.080–0.100 mm long).

Discussion

The species was described by Goto (1899), whose specimens were from the gills of *Remoropsis brachyptera* (Lowe), Rhode Island, Massachusetts.

Price (1938) described and figured *Dionchus agassizi* on the basis of specimens from the gills of *Remoropsis brachyptera* and *Echeneis naucrates* L. at the New York Aquarium; at Woods Hole, Massachusetts; and in the West Indies. The dimensions of the body and organs correspond approximately to those of the specimen (USNM. Helm. Coll. No. 8147 from *Remora remora* (L.), Woods Hole) measured by me and those of the Australian form. Price, however, does not figure the glandular clusters (glands of Goto (?)) between and behind the testes, structures which were also not visible in the specimen from Woods Hole examined by me. The testes, however, are separated by a space filled with vitellaria, and these may cover the glands.

There are no differences in the shape of the hamuli and the other structures.

Price describes a small muscular cirrus in this species and *D. remorae*. Muscular bulbous structures close to the gonopore were seen by me in both species. It is, however, possible, that these are in fact strongly developed bulbous metraterms. Only the examination of serial sections can give a definite clarification of the nature of the structures.

Linton (1940) reported the species from the gills of *Remora remora* at Woods Hole. He figures only the pharynx and hamulus. The latter is identical in shape with that of the Australian form. One specimen of his material was examined by me (USNM. Helm. Coll. 8147). Ktari (1975) found *D. agassizi* together with *D. remorae* on *Echeneis naucrates* in the Mediterranean off Tunisia. Rao and Madhavi (1967) reported *D. agassizi* from the gills of *Echeneis naucrates* in the Bay of Bengal. The illustration of the whole animal and the hamulus, as well as the description, indicate that the specimens are indeed *D. agassizi*. They vary in length from 0.83 to 3.68 mm, approaching that of *D. hopkinsi* (see below).

D. agassizi is very similar to *Dionchus rachycentris* Hargis, 1955, (213–216, figs.

Table 2. *Dionchus agassizi*, *hopkinsi*, and *rachycentris*. Measurements in mm.

Total length	2.3	2.2	2.5	2.2-2.8	2.2	5.1	3.0-3.8	3.6
Width	0.42	0.39	0.42	0.63-0.77	0.47	0.80	0.9-1.6	1.5
Opisthaptor length	0.26	0.13	0.23	—	—	0.30	} 0.29-0.34 diameter	0.35
Opisthaptor width	0.36	0.27	0.29	—	0.17	0.45		0.34
Pharynx	0.13×0.14	0.10×0.12	0.13×0.14	0.095-0.190 ×0.114-0.210	0.13×0.15	0.25 diameter	0.22-0.24	0.23×0.22
Length of prohaptor	0.48	0.44	0.48	—	0.43	—	—	0.76
Max. width of prohaptor	0.48	0.45	0.48	—	0.48	—	—	0.82
Ovary	0.16×0.14	0.10×0.13	0.13×0.14	—	0.13×0.14	—	—	0.29×0.26 approx.
Anterior testis	0.09×0.09	0.10×0.13	0.12×0.13	0.21 diameter	0.13×0.12	0.25×0.15	0.23-0.46 ×0.18-0.43	0.31×0.52
Posterior testis	0.09×0.07	0.11×0.09	0.12×0.12	0.17 diameter	0.14×0.08	0.18-0.12	0.21-0.40 ×0.17-0.27	0.45×0.45
Hamuli	0.097 0.097	0.094 0.076	0.083 0.094	0.095	—	0.16	0.14-0.16	0.15
Marginal hooks	0.012 0.012	0.011 0.012	0.010 0.012	0.015	—	—	0.012-0.015	0.008 0.010 0.010 0.011
<div style="display: flex; justify-content: space-between; padding: 0 10px;"> <div><i>D. agassizi</i>, acc. to Price 1938</div> <div><i>Dionchus agassizi</i> USNM No. 8147 from <i>Remora remora</i>, Woods Hole.</div> <div><i>D. hopkinsi</i> acc. to Koratha, 1955</div> <div><i>D. rachycentris</i> acc. to Hargis, 1955</div> <div><i>D. rachycentrus</i> USNM. No. 38144 Florida</div> </div>								

16–19) which was described on the basis of 11 specimens from the gills of *Rachycentron canadus* (L.) from Louisiana and Florida, Gulf of Mexico. Hargis' measurements are given in Table 2.

Young (1970) reported *D. rachycentris* without description from *Rachycentron canadus* in Moreton Bay near Brisbane, Australia.

Koratha (1955b, 253–254, figs. 2 and 6, see also 1955a) established the species *Dionchus hopkinsi* for 8 specimens from 4 of 9 *Rachycentron canadus* caught off Port Aransas, Texas. The species resembles *D. agassizi* but differs from it, according to Koratha, in the following characteristics: a larger size, finger-like vitellaria, larger hamuli, and different body proportions. Examination of the measurements and figures given by Koratha show that the only significant differences between his species and *D. agassizi* are the larger body size and the larger hamuli. There is no difference in the shape of the hamuli and the shape of the body (he figures an extended specimen identical with the one illustrated by me, whereas Price, 1938, figures a more contracted specimen), and the vitellaria are also finger-like in the Australian *D. agassizi* (see Fig. 3). Minor differences in organ proportions (e.g. relatively smaller testes) may be the result of different body size. In the larger hamuli and its other features, *D. hopkinsi* corresponds to *D. rachycentris*. On this basis, Yamaguti (1963) synonymized *D. hopkinsi* with *D. rachycentris*. The possibility exists that the latter species is a synonym of *D. agassizi*.

Dionchus sp.

Frequency and intensity of infection, locality

3 specimens on 1 of 1 *Rachycentron canadus* (L.) (Rachycentridae) at Heron Island (VI.74).

Specimens deposited in Australian Museum, Sydney, No. W. 9210.

Description (Fig. 4)

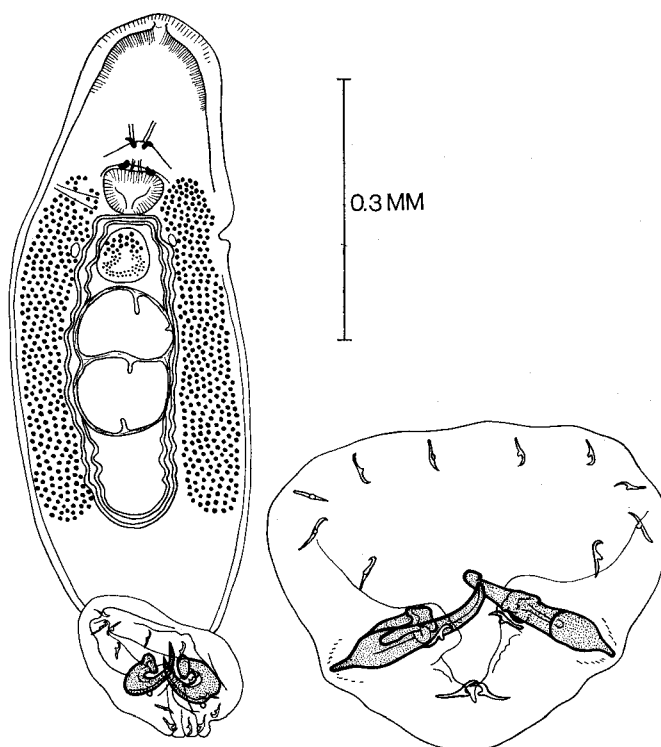
Body smooth or partly scalloped, flat, prohaptor in form of two marginal glandular areas, slight constriction behind prohaptor, pharynx without constriction; two pairs of eyes, one at anterior margin of pharynx, one prepharyngeal; no oesophagus, caeca thick walled without diverticula, joined some distance anterior to opisthaptor. Two large testes tandem in intercaecal field of 2nd third of body, their wall with some deep invaginations. Large ovary in front of anterior testes, not lobed, uterus opens with male gonoduct through common gonopore. Small follicular vitellaria in lateral fields from level of pharynx to end of caeca. Excretory openings at level of ovary.

Opisthaptor clearly separated from body proper, with one pair of large hamuli and 14 marginal hooklets. Hamuli with very large curved and pointed blade and a relatively small base.

All specimens immature, genital ducts therefore not described.

Habitat: gills.

Differential Diagnosis. Differs from all other species of *Dionchus* in its hamuli which

Fig. 4. *Dionchus* sp. from *Rachycentron canadus*, Heron Island.Table 3. *Dionchus* sp. Measurements in mm.

Total length	0.9	0.61	0.85
Max. width	0.25	0.25	0.27
Opisthaptor length	0.16	0.17	0.14
Opisthaptor width	0.20	0.16	0.20
Pharynx	—	0.043 × 0.054	0.058 × 0.076
Prohaptor length	0.25	0.19	0.25
Prohaptor max. width	0.22	0.23	0.22
Ovary	—	—	0.070 × 0.058
Anterior testis	0.082 × 0.100	0.032 × 0.058	0.079 × 0.090
Posterior testis	0.082 × 0.100	0.040 × 0.065	0.090 × 0.120
Hamuli	0.087 0.083	0.072 —	0.072 0.079
Larval hooks	0.018 0.018 0.018	0.018 0.018	0.018 0.018

have a very thick and long curved blade passing over into a small base.

Discussion

The specimens differ markedly from all other species of *Dionchus* in the shape of the hamuli. However, a new species cannot be established because only immature

specimens are available. It cannot be excluded that the examination of mature specimens will show that they belong to a genus (possibly new) closely related to *Dionchus*.

Genus *Sibitrema* Yamaguti

Sibitrema Yamaguti, 1966, 431., fig. 6.

Metapseudaxine Mamaev, 1967. Diagnosis Yamaguti, 1966, 431.

Sibitrema poonui Yamaguti

Sibitrema poonui Yamaguti, 1966, 429–431, fig. 6; 1968, 167–168, fig. 128.

Metapseudaxine ventrosicula Mamaev, 1967.

Frequency and intensity of infection, locality

29 specimens on 6 of 6 *Cybiosarda elegans* Whitley (Scombridae) and 19 specimens on 6 of 9 *Euthynnus alleteratus affinis* (Cantor) (Katsuwonidae) at Heron Island (VI. 74–VIII. 75).

Specimens deposited in Australian Museum, Sydney, No. W. 9211 and USNM. Helm. Coll., Beltsville, Md. No. 74153.

Description (Figs. 5 and 6)

Body smooth or partly scalloped, extremely long, consisting of three parts: a long wide anterior part gradually tapering anteriorly in its anterior half or third, a narrow neck, and a long opisthaptor. Two buccal suckers, pharynx larger than suckers, long wide oesophagus without diverticula, caeca with medial and lateral diverticula, joined in posterior part of opisthaptor and extending as a single caecum with short diverticula to level of most posterior clamps, or not joined and one caecum terminating some distance in front of the other. One row of large irregularly shaped testes at each side of midline from some distance behind caecal bifurcation into neck between wide body part and opisthaptor. At level of ovary testes in one row, in neck of much smaller size and irregularly scattered. Vas deferens strongly winding, muscular genital atrium with single circle of curved terminally bifurcated spines, gonopore midventral halfway between pharynx and caecal bifurcation. Proximal part of ovary deeply lobed, short distance in front of end of wide body part, long ovarian loop directed anteriorly and distal part of ovary directed posteriorly. Follicular vitellaria in lateral fields from caecal bifurcation to end of caeca, extending into median field of neck and opisthaptor. Transverse yolk ducts at midlevel of ovary, common yolk duct directed posteriorly in midline. One row of ventrolateral vaginal openings on each side of body behind level of gonopore, each opening surrounded by muscles. Short genito-intestinal duct present. Opisthaptor long, gradually tapering posteriorly, on one side with one row of clamps of similar size except for most anterior ones in state of formation. Long terminal lappet with one pair of large and one pair of small hooks. Clamps with median sclerite which has one winged and one blunt end and two rows of thorns, two pairs of marginal sclerites and one pair of transverse apical sclerites.

Eggs with filament at each pole.

Habitat: gills.

Differential diagnosis. Narrow "neck" between anterior main part of body and opisthaptor. Testes preovarial, ovarian and postovarial. One row of lateral vaginal openings on each side of body.

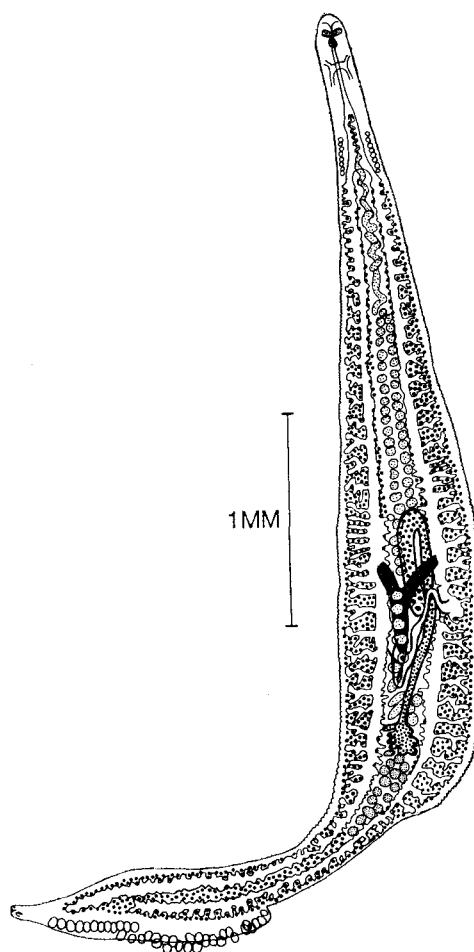


Fig. 5. *Sibitrema poonui* from *Cybiosarda elegans*, Heron Island

Discussion

The form described here closely resembles *Sibitrema poonui* Yamaguti, 1966 from the gills of *Parathunnus sibi* (Kitahara) in Hawaii. Yamaguti established a new genus and subfamily on the basis of a single specimen. His specimen is larger (19.2 mm long), its clamps are about twice as broad, its gonopore is located slightly more posteriorly immediately in front of the caecal bifurcation, and it has two rows of testes at the level of the ovary (one of which has a few scattered testes only). The buccal suckers are of the same size as in the Australian forms and thus relatively much smaller, and

according to the description there are 8–14 vaginae on each side, whereas the drawings show only 8+8.

The larger body size and resulting differences in some organ sizes, and the other differences are not significant and conspecificity of the Hawaiian and Australian

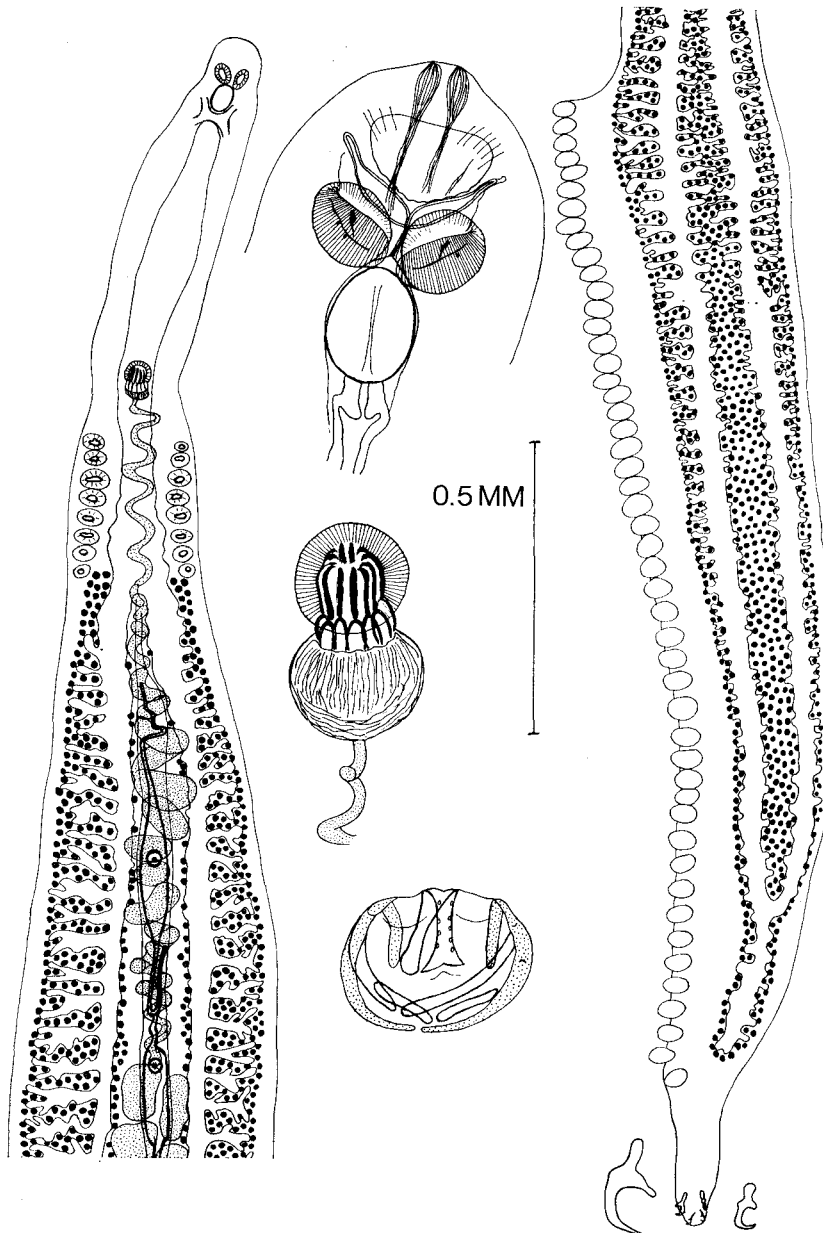


Fig. 6. *Sibitrema poonui* from *Euthynnus alleteratus*, Heron Island.

Left: anterior part. Middle from top to bottom: anterior end, cirrus, clamp.
Right: opisthaptor and hamuli.

Table 4. *Sibitrema poonui*. Measurements in mm

Total length	9.0	9.1	9.2	9.2	4.9	19.2
Max. width of body proper	0.48	0.33	0.49	0.61	0.49	1.4
Length of opisthaptor	1.9	1.7	1.9	2.2	1.1	4.3
Max. width of opisthaptor	0.44	0.36	0.46	0.43	0.38	0.45
Buccal suckers	—	—	—	0.043 × 0.029 0.043 × 0.027	0.043 × 0.040 0.040 × 0.047	0.046 × 0.023 —
Pharynx	—	—	—	0.054 × 0.036	0.054 × 0.043	—
Distance gonopore-anterior end	0.57	0.54	0.57	0.64	0.43	1.45
No. of atrial spines	12	approx. 11	12	12	12	12
Length of cirrus spines	0.040	0.043	0.040	—	0.036	—
No. of vaginal openings	—	—	—	8+6	5+7	8-14 on each side
No. of testestes	—	—	—	—	—	75
No. of clamps	43	47	48	49	29	48
Largest clamp	0.047 × 0.054	0.047 × 0.055	0.043 × 0.058	— × 0.065	0.043 × 0.061	0.090 (width)
Smallest clamp	0.018 × 0.018	approx. 0.018	approx. 0.018	approx. 0.018	0.025 × 0.036	0.050 (width)
Large hooks	0.045 (only 1)	0.047 0.047	0.043 0.043	0.043 0.047	0.040 0.043	0.046
Small hooks	0.021 0.021	0.023 0.023	0.021 0.025	0.025 0.023	0.018 —	0.021
Eggs without filaments	0.230 × 0.057	0.195 × 0.065	0.198 × 0.061	0.270 × 0.064		0.23-0.25 × 0.07-0.09
						<i>Sibitrema poonui</i> acc. to Yamaguti 1966.

forms can be assumed, especially in view of the identical structure of the genital atrium, the clamps, the hooks and the vaginae. It should be pointed out that marine invertebrates from higher latitudes are often larger than those from lower latitudes. An example of Monogenea showing such size differences is *Zeuxapta seriola* (Meserve).

Mamaev (1967) established the new genus and species *Metapseudaxine ventrosicula* for forms similar to *Sibitrema*. The former species was synonymized with the latter by Lebedev (1968).

Genus *Hexotoma* Rafinesque

Synonyms in Sproston, 1946, 502 ff. and Yamaguti, 1963, 203–205.

Hexostoma euthynni Meserve

Hexostoma euthynni Meserve, 1938.

Hexostoma macracanthus Fujii, 1944, 153–154, figs. 1–5.

Neohexostoma euthynni (Meserve, 1938) Price, 1961, 6–8.

Neohexostoma kawakawa Yamaguti, 1968, 144–145, fig. 110.

Probably *Hexostoma pricei* Koratha, 1955a, 270–271, figs. 9, 14, 38, 43, 46.

Neohexostoma pricei (Koratha, 1955) Price, 1961, 6–8.

Frequency and intensity of infection, locality

33 specimens on 6 of 9 *Euthynnus alleteratus affinis* (Cantor) (Katsuwonidae) at Heron Island (VI. 74–II. 75).

Specimens deposited in Australian Museum, Sydney, No. W. 9225 and USNM. Helm. Coll., Beltsville, Md., No. 74151.

Description (Fig. 7)

Body elongate, smooth, widest at levels of ovary and testes, waist-like constriction in pre-testicular region, strongly tapering from level of ovary to anterior end. Two buccal suckers, pharynx, oesophagus, bifurcation of intestine in front of gonopore. Caeca form network of thin canals in dorsal and ventral tissues of entire body except for anterior end but including the opisthaptor; dorsal and ventral reticulum and left and right reticulum communicating. Numerous testes in median field between caeca in last third of body proper terminating short distance in front of opisthaptor. Gonopore medioventral postbifurcal. Ovary in middle of body proper, proximal and distal parts directed posteriorly and close to each other, long coiled loop directed anteriorly. Vitellaria consist of irregular follicles from level some distance behind gonopore to some distance in front of opisthaptor; yolk reservoir and ootype behind ovary, uterus more or less straight in or near midline, opens with male duct through common gonopore. Vaginal opening mediodorsal behind gonopore, vaginal cavity with two coarsely serrated edges.

Opisthaptor continuous with body proper, each side with four sessile clamps decreasing in size posteriorly. One pair of large and one pair of small terminal hooks. Clamps of uniform structure, sucker-like, ventrally with thin transparent membrane, one median and two lateral sclerites. Median sclerite with large

terminal wings anteriorly and small terminal wings posteriorly; lateral sclerites with two large lateral protuberances.

Eggs with one filament at each pole.

Habitat: gills.

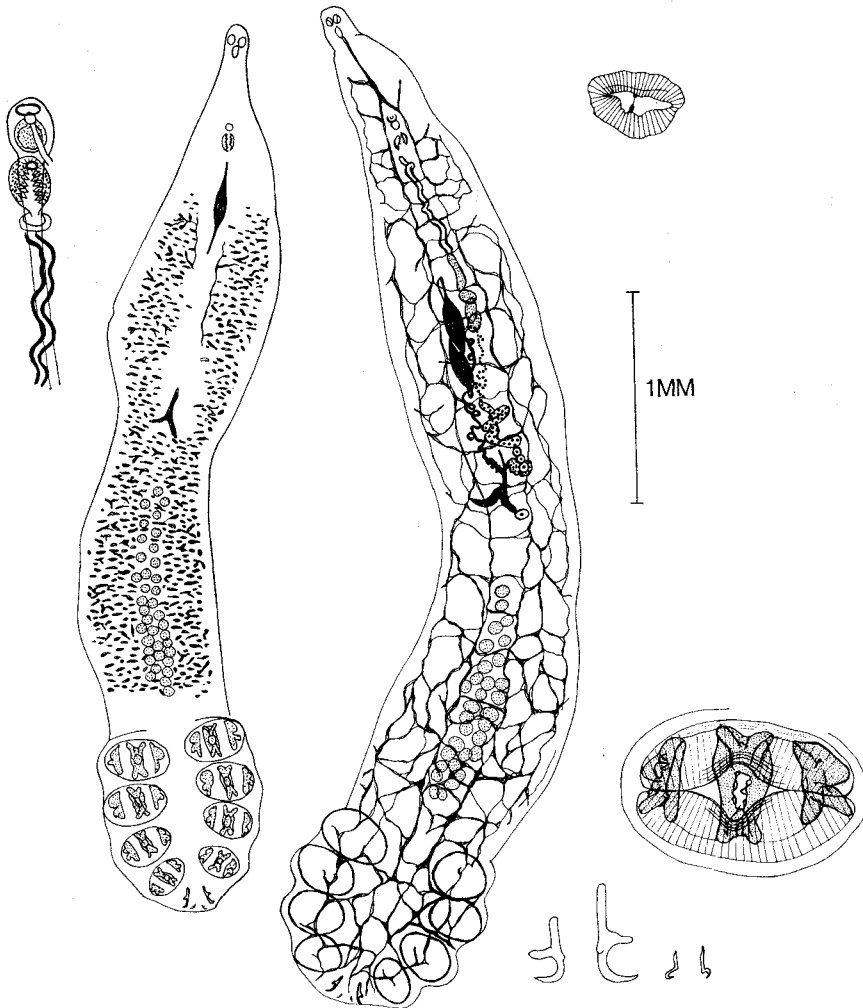


Fig. 7. *Hexostoma euthynni* from *Euthynnus alleteratus*.

Clockwise from left: Common gonopore and vagina; whole mount with vitellaria; whole mount with intestine, sperm duct, ovary, yolk duct and testes; buccal sucker; clamp; larval hooks; hamuli.

Differential diagnosis. Differs from the other species of *Hexostoma* in the combination of the following characters: eight clamps in two more or less parallel rows; constriction of body at pretesticular or testicular level; vagina with two toothed plates; clamps with one median X-shaped and two lateral B-shaped sclerites; maximum body length approximately 8 mm.

Table 5. *Hexostoma euthynni*. Measurements in mm.

Total length	5.5	5.0	3.6–5.9	4.5	5.2	7.7
Max. width of body proper	0.78	0.65	0.75–0.95	—	0.89	1.4
Length of opisthaptor	0.95	0.82	—	—	1.02	1.26
Max. width of opisthaptor	0.84	0.64	—	0.85	1.06	1.60
Buccal suckers	0.047 × 0.040 0.047 × 0.040	0.045 × 0.040 0.047 × 0.041	0.027–0.056 × 0.024–0.040	0.040 × 0.030	0.047 × 0.032 0.043 × 0.036	0.047 × 0.043 0.047 × 0.043
Pharynx	0.083 × 0.040	—	0.044–0.068 × 0.026–0.036	0.075 × 0.045	0.054? × 0.040	0.076? × 0.040
Distance gonopore-ant. end	0.72	0.59	—	—	0.32 (ant. end retracted)	0.83 (ant. end extended)
No. of testes	Many	38	32–40	—	—	—
Largest clamp*	0.22 × 0.27	0.19 × 0.21	0.15–0.26 × 0.22–0.40	0.50 × 0.34	0.19 × 0.30	0.23 × 0.36
Smallest clamp*	0.17 × 0.22	0.13 × 0.17	0.16–0.24 × 0.19–0.33	0.38 × 0.30	0.14 × 0.25	0.20 × 0.25
Length of large hooks	0.101 0.072	0.097 0.108** 0.104 0.108**	0.085–0.120	0.145	0.115 0.115	0.094 0.083
Length of small hooks	—	0.025 0.022	0.024–0.034	—	0.032(?)	0.036 0.032
Eggs (in uterus)	0.21	—	0.103–0.221 × 0.044–0.105	—	0.25 × 0.065	0.23 × 0.084
<div style="display: flex; justify-content: space-between; padding: 0 10px;"> <i>H. euthynni</i> acc. to Millemann, 1956. <i>H. pricei</i> acc. to Koratha, 1955b. <i>Hexostoma macracanthus</i> Type, <i>Euthynnus alleteratus</i>, Florida USNM. Helm. Coll. No. 36890 <i>Neohexostoma kawakawa</i>, Holotyp <i>Euthynnus yaito</i>, Hawaii, USNM. Helm. Coll. No. 63671 </div>						

* Excluding the thin surrounding tegument, but including the thick muscles around skeletal components.

** Hooks of a third specimen.

Discussion

The species described here is identical in most respects with *Hexostoma euthynni* Meserve as described by Millemann (1956). Examination of the description and types of *Hexostoma macracanthum* Fujii, 1944 from *Euthynnus alleteratus*, Florida (USNM. Helm. Coll. No. 36890) and *Neohexostoma kawakawa* Yamaguti, 1963 from *Euthynnus yaito*, Hawaii (USNM. Helm. Coll. No. 63671) also showed that these forms are identical with *H. euthynni* and the Australian form. The only difference appears to be that in the Australian form the testes and vitellaria terminate a short distance in front of the opisthaptor whereas they terminate slightly more anteriorly in the other forms.

The intestine could be traced to the posterior end of the opisthaptor in *N. kawakawa* and in the specimens described here; it was not visible in *N. macracanthum*. It is very likely that it has the same extent in *H. euthynni* and *H. macracanthum*. Already Millemann (1956) synonymized *H. macracanthum* with *H. euthynni*.

H. pricei Koratha, 1955 from the gills of *Sarda sarda* (Bloch) is, according to the description and figures of Koratha (1955b), identical with *H. euthynni*. The only significant difference given in the description is a larger size of the clamps and a slightly larger size of the hamuli (see table); in the figure, however, the clamps have a size similar to that of *N. euthynni*. Holo- and paratypes of the species could not be obtained for examination. It is probable that *H. pricei* is a further synonym of *H. euthynni*. Price (1961) realized the close similarity of both forms, but could not examine type material.

The identical structure of the clamps, the hooks, the genital system (particularly the vaginal dentition) indicate that the specimens described here belong to *H. euthynni*.

Price (1961), who established the genus *Neohexostoma*, gave the following main differences between the new genus and *Hexostoma*. In the former, the clamps are arranged in two more or less vertical rows and the posterior end of the body is therefore not truncate, the posterior clamps are only slightly smaller than the anterior three pairs, there is a constriction of the body in the testicular region, and the vitellaria do not extend posteriorly beyond the distal portion of the testes. In *Hexostoma*, on the other hand, the clamps are arranged in a more or less straight transverse row and the posterior end of the body is therefore more or less truncate, the innermost (posterior) clamps are usually much smaller than the others, and the vitellaria extend into the post-testicular zone.

Yamaguti (1963) added to the diagnosis of the two genera that not only the vitellaria, but also the intestine terminates at the base of the body proper in *Hexostoma*, and a considerable distance anterior to the opisthaptor in *Neohexostoma*.

Examination of a number of type and other specimens and of descriptions of various species showed the following:

Neohexostoma robustum Price, 1961 on *Parathynnus sibi*, tropical Pacific, has oblique transverse rows of clamps with much smaller posterior clamps, as supposedly characteristic of the genus *Hexostoma*. *Hexostoma dissimili* (Yamaguti, 1937) and *H. gros-*

sum (Goto, 1894) have a constriction in the testicular region or in front of the opisthaptor respectively, similar to that of *Neohexostoma*. In *H. auxisi* Palombi, 1943, the posterior clamps are, according to Price (1961), not much smaller than the anterior ones, as expected for species of *Neohexostoma*.

The intestine of *Neohexostoma kawakawa* (Yamaguti, 1963) (holotype USNM. Helm. Coll. No. 63671) extends into the most posterior part of the opisthaptor, as does that of the Australian species. Previous observations on the extent of the intestine are probably incorrect.

The vitellaria of *Neohexostoma euthynni* (Meserve, 1938) terminate at a distance in front of the opisthaptor that is approximately equal to its length (USNM. Helm. Coll. 36890 and description by Fujii, 1944), whereas in the Australian species the vitellaria and testes terminate only a very short distance in front of the opisthaptor, as in a number of species of *Hexostoma*.

The absence of any significant and consistent differences between *Hexostoma* and *Neohexostoma* and the great similarity of some species especially with regard to the structure of the clamps and the genital system, indicate that *Neohexostoma* Price, 1961 must be considered a synonym of *Hexostoma* Rafinesque. The vaginal teeth, for instance, are practically identical in *H. lintoni* Price, 1961, *H. albsmithi* Dollfus, 1962, and *N. euthynni* (Meserve, 1938).

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REFERENCES

- Dollfus, R.-Ph. (1962). Deux espèces de trématodes monogénétiques parasites du "Bluefin Tuna" de Californie. *Ann. Paras. Hum. Comp.* 37, 517-529.
- Fujii, H. (1944). Three monogenetic trematodes from marine fishes. *J. Parasit.* 30, 153-158.
- Goto, S. (1899). Notes on some exotic species of ectoparasitic trematodes. *J. Coll. Sc. Tokyo* 12, 263-295.
- Hargis, W.J., Jr. (1955). Monogenetic trematodes of Gulf of Mexico fishes. Part V. The superfamily Capsaloidea. *Trans. Am. Micr. Soc.* 74, 203-225.
- Johnston, T.H. and Tiegs, O.W. (1922). New gyroductylid trematodes from Australian fishes, together with a reclassification of the superfamily Gyrodactyloidea. *Proc. Linn. Soc. N.S.W.* 47, 83-131.
- Koratha, K.J. (1955). Studies on the monogenetic trematodes of the Texas coast. I. Results of a survey of marine fishes at Port Aransas, with a review of Monogenea reported from the Gulf of Mexico and notes on euryhalinity, host-specificity, and relationship of the Remora and the Cobia. *Contr. Mar. Sc., Texas Univ. Mar. Sc. Inst.* 4, 233-249.

- Koratha, K.J. (1955). Studies on the monogenetic trematodes of the Texas coast. II. Descriptions of species from marine fishes of Port Aransas. Contr. Mar. Sc., Texas Univ. Mar. Sc. Inst. 4, 251-278.
- Ktari, M.H. (1975). The occurrence of two congeneric species of Monogenea on the gills of *Echeneis naucrates* L. (Pisces-Teleostei) collected in Tunisia. Second European Multicolloquy of Parasitology, Trogir (summaries).
- Lebedev, B.I. (1968). Monogeneans of fish of the New Zealand-Australian shelf and of the South-China Sea (Monogenoidea: Gastrocotylidae, Gastrocotylinae). In: Skrjabin, K.I. and Mamaev, Yu. L. ed: Helminths of animals in the Pacific Ocean. Akad. Nauk SSSR, Isd. "Nauka" Moscow (in Russian).
- Linton, E. (1940). Trematodes from fishes mainly from the Woods Hole region, Massachusetts. Proc. U.S. Nat. Mus. 88, 1-172.
- MacCallum, G.A. (1916). Some new species of parasitic trematodes from marine fishes. Zoopathologica 1, 3-38.
- Mamaev, Yu. L. (1967). *Pseudaxine triangula* sp. n. and *Metapseudaxine ventrosicula* gen. et sp. n. and their position in the system of monogeneans. Zool. zh. 46(7), 993-998 (in Russian).
- Millemann, R.E. (1956). Notes on the genus *Hexostoma* (Monogenea: Hexostomatidae) with a redescription of *H. euthynni* Meserve, 1938. J. Parasit. 42, 316-319.
- Price, E.W. (1938). North American monogenetic trematodes. II. The families Monocotylidae, Microbothriidae, Acanthocotylidae and Udonellidae (Capsaloidea). J. Washington Acad. Sc. 28, 109-126.
- Price, E.W. (1961). North American monogenetic trematodes. VIII. The family Hexostomatidae. Proc. Helm. Soc. Washington 28, 4-9.
- Radha, E. (1975). Studies on the monogenean fauna of Madras coast. Riv. Parassit. 36, 7-27.
- Rao, K.H. and Madhavi, R. (1967). A record of *Dionchus agassizi* Goto, 1899 (Monogenea: Capsaloidea) from the suckerfish *Echeneis naucrates* Linnaeus from Bay of Bengal. Current Science 36, 490-491.
- Rohde, K. (1976a). Species diversity of parasites on the Great Barrier Reef. Z. Parasitenk. 46, 93-94.
- Rohde, K. (1976b). Monogenean gill parasites of *Scomberomorus commersoni* Lacépède and other macreral on the Australian east coast. Z. Parasitenk. 51, 49-69.
- Rohde, K. (1977). Habitat partitioning in Monogenea of marine fishes. *Heteromicrocotyla australiensis* sp. nov. and *Heteromicrocotylodes mirabilis* gen. and sp. nov. (Heteromicrocotylidae) on the gills of *Carangoides emburyi* (Carangidae) on the Great Barrier Reef. Z. Parasitenk. 53, 171-182.
- Yamaguti, S. (1963). Systema Helminthum. IV. Monogenea and Aspidocotylea. Interscience Publ. New York-London-Sydney.
- Yamaguti, S. (1966). New monogenetic trematodes from Hawaiian fishes, II. Pacific Science 20, 419-434.
- Yamaguti, S. (1968). Monogenetic trematodes of Hawaiian fishes. Univ. Hawaii Press, Honolulu.
- Young, P.C. (1970). The species of Monogenoidea recorded from Australian fishes and notes on their zoogeography. An. Inst. Biol. Autón. México, ser. zoología, núm. único, 163-176.